

REMARKS

Claims 1-6, 8-15, 17-18, and 20 are pending. Claims 1 and 8 are amended, and claim 7 is canceled in this response. Claims 16 and 19 were previously cancelled. Reconsideration of the application is respectfully requested in view of the following remarks.

I. REJECTION OF CLAIMS 1-2, 5-6, 9, 13 AND 15 UNDER 35 U.S.C. §102(a)

Claims 1-2, 5-6, 9, 13 and 15 were rejected under 35 U.S.C. § 102(a) as being anticipated by U.S. Patent Application Serial No. 2003/0008518 (Chang *et al.* '518). Withdrawal of the rejection is respectfully requested for at least the following reasons. Claim 1 has been amended to include the subject matter recited in claim 7. Chang *et al.* '518 do not teach or suggest a ***low pressure anneal from about one atmosphere of pressure to substantial vacuum*** as claimed in amended claim 1. Rather, Chang *et al.* '518 disclose a furnace baking process can be performed for 30 minutes at a temperature of 400⁰ C (See paragraph 22 and claim 9) and is silent with respect to pressure. Therefore Chang *et al.* do not anticipate independent claim 1 and its associated depending claims. Accordingly, withdrawal of the rejection is respectfully requested.

II. REJECTION OF CLAIMS 1-2 AND 5-6 UNDER 35 U.S.C. §102(a)

Claims 1-2 and 5-6 were rejected under 35 U.S.C. § 102(a) as being anticipated by U.S. Patent Application Serial No. 2003/0104320 (Nguyen *et al.*). Withdrawal of the rejection is respectfully requested for at least the following reasons.

Claim 1 recites performing a ***non-plasma anneal*** on the patterned dielectric layer. Nguyen *et al.* do not teach this feature. In contrast, Nguyen *et al.* ***teach a plasma anneal*** with the plasma power between about 100 W and about 1000 W (See paragraph 22 and claim 23). Furthermore, Nguyen *et al.* do not teach non-plasma anneal on the patterned dielectric layer to ***remove a component of the solvent*** prior to a metal deposition as recited in claim 1. Rather, Nguyen *et al.* teach that the anneal

strips the photoresist with minimal effect on the dielectric constant of the low-k film (See paragraph 22). In addition, claim 1 recites cleaning a polymer residue from surfaces of the patterned dielectric layer **using a wet clean solvent**. Nguyen *et al.* on the other hand relates to a **method to eliminate the wet strip process** to lower cost and avoid solvent handling (See paragraph 9). Therefore Nguyen *et al.* do not anticipate independent claim 1 and its associated depending claims. Accordingly, withdrawal of the rejection is respectfully requested.

III. REJECTION OF CLAIMS 1-2, 4-6, 9 AND 15 UNDER 35 U.S.C. §102(b)

Claims 1-2, 4-6, 9 and 15 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,107,202 (Chiu *et al.*). Withdrawal of the rejection is respectfully requested for at least the following reasons.

Claim 1 recites **patterning a low-k dielectric layer** overlying the wafer. Chiu *et al.* do not teach this feature. Rather, Chiu *et al.* are **silent with respect to a low-k dielectric layer** overlying the wafer. Additionally, claim 1 recites a **non-plasma** process, whereas Chiu *et al.* teach an O₂ ashing **plasma** process (Col. 5, lines 51-53; Col. 8, lines 16-17; Col. 9, lines 63-64). Therefore Chiu *et al.* do not anticipate independent claim 1 and its associated depending claims. Accordingly, withdrawal of the rejection is respectfully requested.

IV. REJECTION OF CLAIM 20 UNDER 35 U.S.C. §102(b)

Claim 20 was rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,107,202 (Chiu *et al.*). Withdrawal of the rejection is respectfully requested for at least the following reasons.

Claim 20 recites performing a plasma strip of an exposed **low-k dielectric material**. Chiu *et al.* do not teach this feature. Rather, as mentioned supra, Chiu *et al.* is **silent with respect to a low-k dielectric layer**. Therefore Chiu *et al.* do not anticipate independent claim 20. Accordingly, withdrawal of the rejection is respectfully requested.

V. REJECTION OF CLAIMS 10-12 AND 14 UNDER 35 U.S.C. §103(a)

Claims 10-12, and 14 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Application Serial No. 2003/0008518 (Chang *et al.* '518). Withdrawal of the rejection of claims 10-12 and 14 is respectfully requested for at least the following reasons.

As stated above, claims 10-12 and 14 each depend upon claim 1, either directly or indirectly, and add further limitations thereto. As highlighted above Chang *et al.* '518 do not teach the invention of claim 1. Accordingly, claims 10-12 and 14 are non-obvious over the cited art, and withdrawal of the rejection is respectfully requested.

VI. REJECTION OF CLAIMS 3, 7-8, 10-12, 14 AND 17-18 UNDER 35 U.S.C. §103(a)

Claims 3, 7-8, 10-12, 14 and 17-18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Application Serial No. 2003/0008518 (Chang *et al.* '518) or U.S. Patent No. 6,107,202 (Chiu *et al.*) or U.S. Patent Application Serial No. 2003/0104320 (Nguyen *et al.*) in combination with U.S. Patent Application Serial No. 2002/0058397 (Smith *et al.*) and U.S. Patent No. 5,643,407 (Chang *et al.* '407). Withdrawal of the rejection of claims 3, 7-8, 10-12, 14 and 17-18 is respectfully requested for at least the following reasons.

Claim 7 is cancelled herein.

Claims 3, 8, 10-12, 14 and 17-18 each depend upon claim 1, either directly or indirectly, and add further limitations thereto. As mentioned above, neither Chang *et al.* '518 nor Chiu *et al.* nor Nguyen *et al.* teach each and every element of independent claim 1. And, Smith *et al.* and Chang *et al.* '407 fail to make up for the aforementioned deficiencies of these references. Accordingly, claims 3, 8, 10-12, 14 and 17-18 are non-obvious over the cited art. Therefore, withdrawal of this rejection is respectfully requested.

VII. REJECTION OF CLAIM 20 UNDER 35 U.S.C. §103(a)

Claim 20 was rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Application Serial No. 2003/0008518 (Chang *et al.* '518) or U.S. Patent No. 6,107,202 (Chiu *et al.*) or U.S. Patent Application Serial No. 2003/0104320 (Nguyen *et al.*) in combination with U.S. Patent Application Serial No. 2002/0058397 (Smith *et al.*), and U.S. Patent No. 5,643,407 (Chang *et al.* '407). Withdrawal of the rejection of claim 20 is respectfully requested for at least the following reasons.

i. Smith et al. and Chang et al. '407 are not properly combinable.

It is admitted in the Office Action that neither Chang *et al.* '518 nor Chui *et al.* nor Nguyen *et al.* teach the low pressure anneal, the temperature, the time, the metal deposition, the acid, and removing the fluorine based solvent as claimed in claim 20. Accordingly, the combination of Smith *et al.* and Chang *et al.* '407 are relied upon for these features.

In order to arrive at the present invention, one of ordinary skill in the art must have been ***motivated to modify Smith et al. and Chang et al. '407.*** It is conceded that such motivation may be found in the references themselves, in the nature of the problem to be solved, or in the knowledge generally available to one skilled in the art. MPEP § 2143.01, citing to In re Kotzab, 217 F.3d 1365, 55 USPQ2d 1313 (Fed. Cir. 2000). ***Nevertheless, such motivation and the source thereof may not be conclusive, but rather the showing must be clear and particular.*** In re Dembicza, 175 F.3d 994; 50 USPQ2D 1614 (Fed. Cir. 1999). It is respectfully submitted that upon a proper analysis of the cited art, and application of the appropriate standard enunciated above, pending claim 20 is non-obvious over the cited art.

Smith *et al.* teach that in fabricating an electronic device the ***use of any oxygen is excluded*** due to the deleterious effects of oxygen based plasma on carbon containing oxide. This can cause the carbon containing oxide to lose carbon showing

degradation in low k materials using standard photoresist removal processes (e.g., O₂, 250⁰C) (See paragraphs 5 and 24). In contrast, Chang *et al.* '407 teach the **use of oxygen both in the wet strip process, hydroxylamine (NH₂OH), and the optional step of O₂ plasma ashing** (See Col. 3, lines 17-22). The cited art provides no teaching or suggestion to combine these references or any advantages associated therewith. Rather, Smith *et al.* specifically exclude the use of oxygen in the photoresist process, whereas Chang *et al.* '407 teach the use of oxygen in the photo-mask removal process. Therefore one of ordinary skill in the art would not be motivated to combine together the cited references.

Therefore it is inappropriate combine the teaching of Smith *et al.* and Chang *et al.* '407, as the examiner suggests, in order to reconstruct applicants' claim. Therefore it is respectfully submitted that claim 20 is non-obvious over the cited art. Accordingly, a reversal of the rejection of claim 20 is respectfully requested.

ii. Chang et al. '518, Smith et al. and Chang et al. '407 are not properly combinable.

As discussed *supra*, Smith *et al.* teach that in fabricating an electronic device the **use of any oxygen is excluded** due to the harmful effects of oxygen based plasma upon carbon containing oxide. The carbon containing oxide can lose carbon showing degradation in low k materials using standard photoresist removal processes (See paragraphs 5 and 24). In contrast, Chang *et al.* '518 and Chang *et al.* '407 both teach the **utilization of oxygen in the various processes**. Chang *et al.* '407 teach the **use of oxygen both in the wet strip process, hydroxylamine (NH₂OH), and the optional step of O₂ plasma ashing** (See Col. 3, lines 17-22). Chang *et al.* '518 teach **oxygen plasma reacts with carbon** and hydrogen atoms in the photoresist layer to form gaseous carbon dioxide and water vapor so as to strip the photoresist layer (See paragraph 21). The cited art provides no teaching or suggestion to combine these references or any advantages associated therewith. Rather, Smith *et al.* specifically exclude the use of oxygen in the photoresist process, whereas Chang *et al.* '518 and

Chang *et al.* '407 teach the use of oxygen plasma in the photoresist strip process. Therefore there is no motivation to combine Chang *et al.* '518 with Smith *et al.* and Chang *et al.* '407.

iii. Chui *et al.*, Smith *et al.* and Chang *et al.* '407 are not properly combinable.

Smith *et al.* teach the **exclusion of oxygen** due to the harmful effects of oxygen reacting with carbon containing oxide causing degradation of carbon in standard photoresist removal processes (See paragraphs 5 and 24). In contrast, Chui *et al.* teach performing a **first O₂ ashing treatment** of the photoresist pattern (See Col. 3, lines 26-27). As discussed *supra*, Chang *et al.* '407 teach the **use of oxygen both in the wet strip process, hydroxylamine (NH₂OH), and the optional step of O₂ plasma ashing** (See Col. 3, lines 17-22). The cited art provides no teaching or suggestion to combine these references or any advantages associated therewith. Rather, Smith *et al.* specifically exclude the use of oxygen in the photoresist process, whereas Chui *et al.* and Chang *et al.* '407 teach the use of oxygen in the photoresist strip process. Therefore there is no motivation to combine Chui *et al.* with Smith *et al.* and Chang *et al.* '407.

iv. Nguyen *et al.*, Smith *et al.* and Chang *et al.* '407 are not properly combinable.

Smith *et al.* teach the **exclusion of oxygen** due to the harmful effects of oxygen reacting with carbon containing oxide (See paragraph 5 and 24). Contrary to Smith *et al.*, Nguyen *et al.* teach removing a residue of the photoresist **using a plasma comprising hydrogen and H₂O (oxygen)** (See claims 6, 7 and 11). As discussed above, Chang *et al.* '407 teach the **use of oxygen both in the wet strip process, hydroxylamine (NH₂OH), and the optional step of O₂ plasma ashing** (See Col. 3, lines 17-22). Therefore, the cited art provides no teaching or suggestion to combine these references or any advantages associated therewith. Rather, Smith *et al.*

specifically exclude the use of oxygen in the photoresist process, whereas Nguyen *et al.* and Chang *et al.* '407 teach the **use of oxygen** in the photoresist strip process. Therefore there is no motivation to combine Nguyen *et al.* with Smith *et al.* and Chang *et al.* '407.

Based upon the findings above in sections ii, iii, and iv, it is inappropriate combine the teaching of Chang *et al.* '518 or Chiu *et al.* or Nguyen *et al.* in combination with Smith *et al.* and Chang *et al.* '407, in order to reconstruct applicants' claim 20. Therefore it is respectfully submitted that claim 20 is non-obvious over the cited art. Accordingly, a reversal of the rejection of claim 20 is respectfully requested.

v. **Assuming arguendo that Smith *et al.* is removed from the various combination of references, the other cited references are not properly combinable. Neither Chang *et al.* '518 nor Chiu *et al.* nor Nguyen *et al.* in combination with Chang *et al.* '407 are obvious over claim 20.**

To make a suggested combination, one of ordinary skill in the art must have been motivated to modify the cited references, where such motivation may be found in the references themselves, in the nature of the problem to be solved, or in the knowledge generally available to one skilled in the art. MPEP § 2143.01, citing to In re Kotzab, 217 F.3d 1365, 55 USPQ2d 1313 (Fed. Cir. 2000). Nevertheless, such motivation and the source thereof may not be conclusory, but rather **the showing must be clear and particular**. In re Dembiczkak, 175 F.3d 994; 50 USPQ2D 1614 (Fed. Cir. 1999). It is respectfully submitted that upon a proper analysis of the cited art, and application of the appropriate standard enunciated above, pending claim 20 is non-obvious over the cited art.

a. **Chang *et al.* '518 and Chang *et al.* '407 are not properly combinable.**

Chang *et al.* '518 teach a method to **avoid deterioration** of a dielectric characteristic of a dielectric layer having a low dielectric constant (low k) **during a**

stripping process. (See abstract). Furthermore, Chang *et al.* '518 teach the use of HMDS to **repair the surface of the low k dielectric layer that is damaged during the stripping process** (See paragraph 12). In contrast, Chang *et al.* '407 teach that once the via etching is complete, the **photoresist mask is removed using a wet strip**, such as hydroxylamine (See Col. 3, lines 19-20). Chang *et al.* '407 teach a method of forming the intermetal dielectric layer of an integrated circuit which does not result in poisoned via metallurgy. Consequently, Chang *et al.* '407 **is silent with respect to a process step to repair the surface of the low k dielectric layer that is damaged during the stripping process** because no repair is necessary. There would be no motivation in Chang *et al.* '407 to create an additional process step to repair damage to the dielectric layer that hadn't been identified. Therefore one of ordinary skill in the art would not be motivated to combine together Chang *et al.* '407 and Chang *et al.* '518.

Therefore it is inappropriate to combine the teaching of Chang *et al.* '407 and Chang *et al.* '518 in reconstructing applicants' claim 20.

b. Chui *et al.* and Chang *et al.* '407 are not properly combinable to teach all of the features as recited in claim 20.

Chiu *et al.* teach a method for **stripping positive photoresist from a keyhole in a passivation layer before a heating process using NMP solvent strips after a photoresist strip** (See abstract, Col. 3, lines 2-7). In contrast, Chang *et al.* '407 teach the photoresist mask is removed using a wet strip, such as hydroxylamine **followed by an O₂ plasma ashing at a temperature of between about 170⁰ to 275⁰ and a vacuum baking** (See Col. 3 lines 17-32). In other words, Chang *et al.* '407 teach an O₂ plasma ashing and vacuum bake immediately after stripping the photoresist. Thus Chang *et al.* '407 does not ensure that the photoresist residue is completely removed from the keyholes, as in Chiu *et al.*, before performing a heating process. Thus the Chang *et al.* '407 process does not eliminate the potential for detrimental photoresist extrusions.

Therefore, both Chui *et al.* and Chang *et al.* '407 are not properly combinable in reconstructing applicants' claim 20.

c. Nguyen *et al.* and Chang *et al.* '407 are not properly combinable to teach all of the features as recited in claim 20.

The references of Nguyen *et al.* and Chang *et al.* '407 are not properly combinable. In particular, Nguyen *et al.* uses a method to **eliminate the wet strip process to lower cost and avoid solvent handling** (See paragraph 9). In contrast, Chang *et al.* '407 teach once the via etching is complete, the **photoresist mask is removed using a wet strip** (See claim 7). Obviously, a clear emphasis of Nguyen *et al.* is in overcoming the wet strip process whereas Chang *et al.* '407 utilizes a wet strip as part of the overall method. It is respectfully submitted that, taken as a whole, one of ordinary skill in the art would not look to a design that adds a wet process as in Chang *et al.* '407 to a process as in Nguyen *et al.* which clearly eliminates that very step.

The standard for ascertaining whether a combination is appropriate is whether a clear and particular motivation may be found in the references themselves, in the nature of the problem to be solved, or in the knowledge generally available to one skilled in the art. *In re Vaeck*, 947 F.2d 488; *In re Dembiczkak*, 175 F.3d 994; 50 USPQ2D 1614 (Fed. Cir. 1999); MPEP § 2142. Since the references have divergent goals, any motivation to make the suggested combination is clearly lacking in the references themselves and in the art generally. Accordingly, to the extent that any such motivation exists, it is most certainly inspired by the pending claims, and thus makes use of impermissible hindsight where the pending claims are substituted for the necessary motivation.

As such, as outlined in **section V, subsections a, b, and c**, "Chang *et al.* '518 and Chang *et al.* '407" or "Chui *et al.* and Chang *et al.* '407" or "Nguyen *et al.* and Chang *et al.* '407" are not properly combinable. Therefore it is respectfully submitted that claim 20 is non-obvious over the cited art. Accordingly, withdrawal of the rejection with respect to claim 20 is respectfully.

VIII. CONCLUSION

For at least the above reasons, the claims currently under consideration are believed to be in condition for allowance.

Should the Examiner feel that a telephone interview would be helpful to facilitate favorable prosecution of the above-identified application, the Examiner is invited to contact the undersigned at the telephone number provided below.

Should any fees be due as a result of the filing of this response, the Commissioner is hereby authorized to charge the Deposit Account Number 20-0668, TI-33260.

Respectfully submitted,
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CERTIFICATE OF MAILING (37 CFR 1.8a)

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Date: June 27, 2006



Christine Gilroy